

Claims

What is claimed is:

- 1 1. A method for forming a quadruple density sidewall image
2 transfer (SIT) structure comprising the steps of:
3 forming oxide spacers on opposite sidewalls of a first mandrel; said
4 oxide spacers forming a second mandrel;
5 forming sidewall spacers on opposite sidewalls of said oxide spacer
6 second mandrel; and
7 using a pattern of said sidewall spacers to form the quadruple density
8 sidewall image transfer (SIT) structure.

- 1 2. A method as recited in claim 1 wherein the step of forming
2 oxide spacers on opposite sidewalls of said first mandrel includes the steps
3 of providing a starting structure including multiple layers; said multiple layers
4 including a substrate, a gate dielectric layer, and a gate conductor.

- 1 3. A method as recited in claim 2 wherein said multiple layers of
2 said starting structure further include an oxide hardmask layer, a poly etch
3 stop layer, a first nitride layer, and a poly mandrel layer capped with a
4 second, thinner nitride layer.

- 1 4. A method as recited in claim 3 wherein the step of forming
2 oxide spacers on opposite sidewalls of said first mandrel further includes the
3 steps of providing a print mandrel mask on said starting structure; using said
4 print mandrel mask and etching said second, thinner nitride layer and said
5 poly mandrel layer to define said first mandrel; and removing said print
6 mandrel mask.

- 1 5. A method as recited in claim 4 wherein the step of forming said
2 oxide spacers on opposite sidewalls of said first mandrel further includes the
3 steps of thermally growing oxide hardmask spacers on opposite sidewalls of
4 said first mandrel.

1 6. A method as recited in claim 5 further includes the step of
2 filling any undercut profile of said thermally grown oxide hardmask spacers
3 on opposite sidewalls of said first mandrel using a thin Chemical Vapor
4 Deposition (CVD) oxide.

1 7. A method as recited in claim 5 further includes the step of
2 removing said first mandrel.

1 8. A method as recited in claim 4 wherein the step of forming
2 sidewall spacers on opposite sidewalls of said oxide spacer second mandrel
3 includes the steps of forming nitride hardmask spacers on opposite
4 sidewalls of said oxide spacer second mandrel.

1 9. A method as recited in claim 8 includes the steps of forming
2 said nitride hardmask spacers by conformal deposition and directional etch
3 of a nitride layer on opposite sidewalls of said oxide spacer second mandrel.

1 10. A method as recited in claim 8 includes the steps of removing
2 said oxide spacer second mandrel; and removing said first nitride layer, said
3 poly etch stop layer, and said oxide hardmask layer by Reactive Ion Etching
4 (RIE), while maintaining a profile and a width of said nitride hardmask
5 spacers.

1 11. A method as recited in claim 8 wherein the step of using said
2 pattern of said sidewall spacers to form the quadruple density sidewall
3 image transfer (SIT) structure includes the steps of transferring said pattern
4 of said nitride hardmask spacers into said poly etch stop layer, and said
5 oxide hardmask layer to form the quadruple density sidewall image transfer
6 (SIT) structure.